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ABSTRACT

Instructional design considerations involved in using level four videodisc systems when designing simulations are explored. Discussion of the hardware and software system characteristics notes that computer based training offers the features of text, graphics, color, animation, and highlighting techniques, while a videodisc player offers all of the traditional audiovisual training media attributes of audio, running video, and still pictures. Various instructional design issues are investigated, including those relating to media characteristics and media integration, interactive videodisc simulation design considerations, and a team approach to designing and developing simulations using these systems and the required skill sets. Additional discussion briefly examines emerging technologies such as artificial intelligence and knowledge-based systems and the promise of their use with simulations. Ten references are listed. (LMM)

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SIMULATIONS USING A COMPUTER/VIDEODISC SYSTEM: INSTRUCTIONAL DESIGN CONSIDERATIONS

Paper Presentation at the annual meeting of
North American Simulation and Gaming
Association, Iowa City - 1984

by

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Introduction

The technique of simulation is becoming increasingly popular in both training and educational environments. In its essence the technique of simulation consists of placing an individual in an environment that is constructed so as to imitate, but not duplicate, some part of reality. This technique requires that the learner be an active participant in this process. The essence of simulation is the model that is developed to represent a portion of the world. It is this model with all its delimiting parameters and static or dynamic variables that creates the nucleus around which a simulation is built. The degree of association between the model and what it intends to represent defines the realism of the simulation (Cruickshank and Mager, 1976; Duggan et al., 1970).

With the advancing technologies associated with interactive videodisc systems, problem solving simulations take on a enhanced veneer. Through the use of computer-based instruction techniques and audio-visual methods, interactive videodisc systems enable the instructional designer to intergated these technologies, thus facilitating a finer representation of the simulated system. While the use of interactive videodisc systems are both exciting and help to enhance the learning experience, this is all facilitated by sound instructional designs. The ultimate responsibility and challenge of design lies on the shoulders of the instructional designer. It is the instructional engineer who must delicately orchestrate the learning goals and objectives with this media environment to create a rich instructional experience.

This paper will begin to explore some of the instructional design considerations around the use of Level four videodisc systems when designing simulations. The hardware and software system characteristics will first be discussed. Various instructional design issues will be investigated including discussions around media characteristics and media intergration issues, interactive videodisc simulation design considerations and some discussion will be presented around a team approach to designing and developing simulations using these systems and the required skill sets. Lastly, some discussion concerning emerging technologies and the promise of their use with

simulation designs will be presented.

Hardware and Software Characteristics

The hardware and software integration of microcomputer and videodisc technology affords instructional designers a unique and challenging training medium. This individualized environment offers the capabilities of computer-based instruction and audio-visual technologies within a single delivery system. These systems may be used to present instruction, assess learner comprehension or as evaluation instruments. The challenges of designing for this rich training environment lies in the learned hands of evaluators and instructional designers.

In order to better understand issues and considerations for designing instruction and evaluation tools using an interactive computer/videodisc system, it is important to investigate the media attributes available with this medium. The use of the computer as a training medium offers all the features of conventional computer-based instruction (CBI):

- o text
- o graphics
- o color
- o animation
- o highlighting techniques
  - bolding
  - underlining
  - blinking
  - reverse video

The videodisc player offers all of the traditional audio-visual training media attributes:

- o audio
- o running video
- o still pictures (without audio)
  - video
  - artwork
  - slides
  - genigraphics

Depending on the delivery system's hardware and software capabilities, the characteristics of videodisc and CBI may be blended to produce a unified instructional message. For example, traditional CBI can use one of the audio tracks on the videodisc player to enhance the primarily text and graphic presentation of the computer.

When designing materials using these powerful delivery systems it is important that the designer to be intimately familiar with what the hardware and software system can and cannot do. It is so very important that the materials be designed fully understanding the limitations of the target delivery system.

Instructional Design Issues

This section will begin to explore related instructional design and development issues. Further discussion of media characteristics and how these media may be intergrated will be presented first. Discussion concerning instructional design issues specific to interactive videodisc systems will comprise a major portion of this section. Lastly, discussion and conjecture about some of the emerging techologies will be presented.

Media Characteristics and Intergration

There are various ways in which interactive videodisc system may be configured, the following discussion highlights these systems. Some computer/videodisc systems use two-screen presentation, with one screen for computer-generated output and the other screen for videodisc images. With these systems the learner is directed to view the current instructional message from the appropriate screen. Student interaction with the instruction may occur through either screen, depending on the system hardware and software capabilities.

Other systems use one screen (usually an NTSC monitor although high resolution graphics terminals also are used with more sophisticated systems) to display both computer-generated output and videodisc images. Most of these one-screen systems allow either computer-generated output or visuals from the videodisc on the screen at any one time. Some of the more advanced systems allow the computer-generated output to be overlaid directly on top of the visual images from the videodisc. In other words, the computer and videodisc output may appear concurrently on the screen.

In any of these systems, the learner may interact with a keyboard, joystick, touch screen or voice. The limits to learner interaction are defined primarily by hardware and software configuration.

Integration of the available media capabilities of a computer/videodisc training system are determined by appropriate instructional design strategies and message design techniques. The particular configuration of a system will directly influence instructional and message design decisions. Hiscox (1981) summarizes the success of this medium in stating,

> The success of the videodisc in instruction will depend largely on how well they [videodics] maintain students motivation by providing attainable goals, frequent feedback, appropriate difficulty and minimized failure, and whether

> they allow for such individual differences as attributes and interests, time required for learning, students' knowledge base, and generalized ability. (Hiscox, 1981, p. 1)

In sum, how the instructional engineer chooses to design the instructional presentation has a direct effect on the 'quality' of the learning experience. If the media is inappropriately 'matched' to the instructional objectives and the instructional strategy, the burden of the learning will be placed on the student. The fault here lies with the design and not with the instructional system. It is important to consider faulty designs and not the medium when the learners do not reaching mastery.

Interactive Videodisc Simulation Design Considerations

The author assumes that the reader is familiar with designing interactive simulations in either paper-based or computer-based formats. This discussion will begin with a definition of simulations. Discussion will continue by comparing and contrasting instructional and evaluative simulations and related instructional design considerations.

Simulations allow learners the flexiblity of trying alternative strategies and solutions to problems and situations presented. Students can be placed in situations which are similar to actual environments without being exposed to all the confounding limitations of the true system. Learners can readily see the results and ramifications of various choices they make, thus, creating a dynamic learning environment. Students can experiment within this safe environment and not worry about how decisions made affect the actual environment. Learners have the freedom to make mistakes without having to face the consequences the real setting.

Instructional Simulations

Simulations, in education and training, are used both for instruction and evaluation. An instructional simulation may present a student with a problem solving situation requiring appropriate decision making processes. The student, after appraising the initial problem situation, requests additional information eventually leading to resolution of the problem. It is through this decision making process that learning may occurs.

> In simulation it is possible to extract a critical and planned segment of an often complex and unpredictable world; to control the evolution or sequence of important variables; to provide learners with opportunities for independent action without doing harm to either subject or object; and through this dynamic mechanism to provide immediate feedback of consequences of an intervention, not merely information about what might transpire. It is an instructional form that focuses upon use rather than mere possession of knowledge. (Miller, 1968, p.67)

There are a number of instructional strategies used for providing instruction within simulations. In some simulations, if an inappropriate procedure or request is chosen, the student may receive instructional feedback signaling the incongruous nature of the choice. This feedback could state the possible ramification of the decision, (thus allowing the student to reconsider the decision) or may present a remedial instructional segment designed to help rectify a student's misunderstanding. Other instructional simulations allow the student freedom in solving the problem without instruction or feedback presented during the process. At the conclusion of the simulation, a discussion is presented highlighting student deviation from the best or "optimal" decision making route.

Some primary purposes of instructional simulations are: a) to teach about the environment which is being simulated; b) to allow interaction with the simulation model; and c) to remediate areas of knowledge and/or skills specific to the simulation, where assessment of learners' understanding has been identified as being weak or insufficient. Instructional simulations posses specific learning and terminal objectives and utilize instructional feedback. A goal of instructional simulations require translation of skills and knowledge from the simulated environment to the actual environment.

Evaluative Simulations

Evaluative simulation measures a person's ability to function appropriately within a given environment; the primary intent is to evaluate competencies and not to teach proper problem solving behaviors (Friedman, 1978; McGuire, 1974). The student is presented with the initial problem situation and required to reach closure; feedback is offered only in the form of appropriate responses to student requests.

An evaluative simulation attempts to create an environment that requires an examinee to demonstrate competence in the problem solving and decision making skills necessary for adequate performance. This is accomplished by allowing the examinee to interact with a model of reality which closely imitates the real world environment.

> Competence is distinct from and somewhere in between knowledge and performance. Competence is taken to mean using knowledge to solve problems and is taken to be potentially useful as a predictor of later performance. (Senior, 1976, p. 16)

It is important to keep in mind that when the simulation is being used as a test of knowledge or competencies that the feedback simply explain or state how the option choice affected the situation. This feedback should not instruct, coach or cue the learner in any way. If the feedback does, this will cause the instrument to lose its ability to assess what the learner knows or how they would probably perform in the given situation.

The learner progresses through the simulation making choices from presented option lists, receiving feedback and continuing to make option choices in light of the feedback. The simulation allows each learner the ability to create her/his own path or route as progress is made through the instrument. The routes are uniquely defined by the choices which are made.

When using simulation techniques for the purpose of evaluating individual competence, it is necessary to identify exactly which aspects of competence are to be measured. Attention must be given to the levels of knowledge and skill which are desired as well as to previous educational experience. After these specific items are identified, then attention should be directed towards constructing an environment which resembles, as closely as possible, the real life performance that is being evaluated. For example, if the purpose of the evaluative simulation is to assess how well a doctor will manage a patient with a heart attack, then the simulation must realistically afford her/him the opportunity to diagnosis and manage a simulated patient with this acute condition.

There are some aspects of reality that cannot be simulated. These limitations translate into constraints placed on the model. It is critical to identify these constraints which are not incorporated within the model. Any generalizations of examinees' performance on this measurement instrument must be prefaced by a caveat regarding those aspects of reality which could not be simulated. Thus, it is important to be very careful about predicting individual performance on the basis of responses to the simulated situation. At best it is

only possible to predict how well an individual is capable of behaving and not how s/he will behave in a real environment.

Although it is true that the essence of simulation techniques are no different whether a branching paper-based format, or, a computer-based format, or, interactive video format is used, the real difference lies in the complexity of the instructional strategies. Simulations techniques remain relatively constant but how 'real' the experience is for the learner is heightened by the available media. This is where interactive videodisc surpasses previously used simulation media. Sequences which require motion are easily presented, or if sound is critical it is available. The ability to overlay computer generated text and graphics are excellent ways of highlighting and focusing learning.

The most fundamental and important message to the instructional designer is to plan, up front, what your instructional message and strategies are. Decide what is the best way to present each strategy and to communicate your intents via your scripts, storyboards and flowcharts. Failure to plan your every design consideration and intent will result in a poorly architectured simulation design and presentation which probaly took longer to develop.

Design/Development Team Skill Sets

For an interactive videodisc project to be successful it usually requires a number of skills. The overall project may be divided into the following phases:

- Design
- Courseware Development
- Video Production
- Courseware/Video Merge
- Evaluation
- Delivery

The skill sets necessary for an interactive videodisc project are:

- Project Management
- Instructional Design
- Subject Matter Expert
- Evaluation
- Visual Design
- Scriptwriting
- Program Analysis
- Video Production
- Sofware Coding

Each skill set is required within one or more of the overall project phases. The following is a brief discussion of the responsibilities associated with each skill set.

- Project Management
  - Assumes overall responsibility for business and project management.
  - This skill is required throughtout the life of the project.
- Instructional Design
  - Responsible for defining instructional goals, conducting learner analysis, designing task analysis, writing instructional objectives, the learning and media strategies, coordinating script and storyboard development, reviewing and editing course materials.
  - This skill is required primarily in the design and merging phases.
- Subject Matter Expert
  - Responsible for all course content accuracy, works with instructional designer to develop course objectives and content, and reviews all course materials.

- This skill is required primarily in the design, merging and evaluation phases.

o Evaluation

- Design and develop all course assessment materials and for course data gathering and analysis.

- This skill is required primarily in the evaluation phase.

o Visual Designer

- Develop screen standards and screen grids and contribute to the development of the storyboards.

- This skill is required primarily in the design and development phases.

o Scriptwriting

- Write an audio and visual narrative script from the course design specification.

- This skill is required primarily in the design phase.

o Program Analysis

- Consult with the instructional designer in terms of software implementation, write course routing and flowcharts and supervise software reliability testing.

- This skill is required primarily in the design development and merging phases.

o Video Production

- Design video treatments, assist with script and storyboard production, cooridinate pre-production, production and post-production activities, supervise videodisc pressing and disc logging.

- This skill is required primarily in the design video production and merging phases.

o Software Coding

- Implement all software development from the storyboards and flowcharts.

- This skill is required primarily in the development merging phases.

In summary, an interactive videodisc project require unique skill sets which must be expertly blended during all project phases. Most successful projects require a well managed team.

Emerging Technologies

This section will take a moment to look into the future and see what technological advances lie ahead for simulation designs.

To date, all interactive simulations require a tremendous amount of design and strategy planning. While some simulation designs create 'dynamic' situations these situations are tightly controlled. We are beginning to see the exploration of 'artifical intelligence' technology used with simulation techniques. This is most notably occurring in the health sciences.

Intelligent CAI systems attempt to reconstruct the reasoning powers of experts. "The distinctive characteristics of these systems is that their logic processes are state-driven rather than hard-coded. That is, one "programs" a knowledge-based system by writing a set of logic rules that the system digests during initialization. Program branching is then controlled by these rules rather than by IF/THEN structures hard-coded in the source program." (Heines, 1983)

The use of intelligent CAI techniques in medical training has unprecedented potential. The most famous medical application of a knowledge based system is MYCIN. This program identifies bacterial diseases from a large number of characteristics of cultures grown from simple bacteria. An educational extention of the MYCIN program is NEOMYCIN, a computer-assisted instruction program that teaches the diagnosis of bacterial diseases.

The use of knowledge based systems in the medical care environment forces experts to begin to objectify their problem solving processes. The primary component of these systems lies in their ability to reconstruct the information schema of the expert thru software modeling. It is when experts can objectify their problem solving processes that intelligent systems will to emerge as an instructional medium. This environment is the next logical step for simulation designs, it will allow the system to 'think' and evaluate it's environment. Once problem solving process are modeled then instructional strategies used to teach these processes may be designed with finer instructional adaptability and tailoring thru artificial intelligence

techniques.

Summary

This paper began with discussion of some instructional design considerations around the use of level four videodisc systems for designing simulations. The hardware and software system characteristics were discussed. Various instructional design issues were investigated including discussions around media characteristics and media intergration issues, interactive videodisc simulation design considerations and some discussion of a team approach to designing and developing simulations using interactive videodisc systems and required skill sets. Lastly, some discussion concerning emerging technologies and the promise of their use with simulation designs was presented.

Is should be clear from the foregoing discussions that an instructional designer using interactive videodisc systems must pay close attention to the available media and how this media may be intergrated. Simulations techniques remain relatively constant but how 'real' the experience is for the learner is heightened by the available media. This is where interactive videodisc surpasses paper-based and computer-based simulation media. How the instructional engineer chooses to design the instructional presentation has a direct effect on the 'quality' of the learning experience.

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